SCIENCE.

FRIDAY, JULY 9, 1886.

COMMENT AND CRITICISM.

NOT INFREQUENTLY STATEMENTS APPEAR of the death of some individual who has passed his hundredth year. The evidence in these instances of great longevity is, as a rule, exceedingly unreliable, and oftentimes there is not so much as an entry in a family Bible upon which to rest the claim. Professor Humphrey of England has determined to investigate, so far as he can, these reported cases, and is now collecting the information from every available source. While there can be no doubt that there have been many true claimants to the title of centenarians, yet it will probably be found, as a result of Professor Humphrey's labors, that a not inconsiderable number have falsely or ignorantly laid claim to an honor which they did not deserve.

THE EXAMINATION OF THE BRAIN of the late King of Bavaria by six of the medical profession of Germany has resulted in confirming the opinion of his physicians given during his lifetime, that he was insane. Marked changes of the brain substance and its membranes, and also of the bones of the skull, were found; some of them showing evidences of having existed for a considerable time, and others of more recent formation. These signs of degeneration, coupled with the idiosyncrasies which marked the later years of his reign, leave but little room for doubt as to the insanity of King Louis.

FROM TIME TO TIME epidemics of scarlet-fever more or less extensive have been traced to the dairy. The usual history has been that of some attendant, while convalescing from the disease, and before the skin had thoroughly desquamated, being found in the act of milking. Portions of skin containing the infectious material have thus found their way into the milk, and the disease has appeared among the consumers. Another method by which this disease may be propagated has just been brought to light by Professor Cameron of London. He finds that the cows themselves may have scarlet-fever; and in an epidemic recently investigated by him, this was, in his opinion, the source of infection in a family attacked with the disease. Dr. Cameron regards it as occurring usually in the first instance in newly-calved cows, and communicated to healthy cows by the hands of those who do the milking. The symptoms in the cow are very similar to those observed in the human species, including fever, sore throat, discharges from the nostrils, and an eruption upon the skin.

THE SEARCH FOR THE GERM of hydrophobia, or rabies as it should more properly be termed, has up to very recent date been unsuccessful. The London *Lancet* announces that Dr. Dowdeswell claims to have found it in the central canal of the spinal cord and in the medulla oblongata. He has also found it in other parts of the brain and cord, but not in such abundance. He describes it as a micrococcus, and accounts for the failure of others to find it, by the fact that the hitherto known methods of staining will not affect it. He will shortly describe his own method, and an opportunity will then be given to experts to examine the evidence on which he bases his claim: until then the matter remains *sub judice*.

THE FIELD-WORK of the coast and geodetic survey is almost at a standstill. owing to the lack of money to conduct it. Only those parties are at work which had been sent out prior to the close of the fiscal year. The parties on the transcontinental arc will be put in the field as soon as the appropriation passes. All the parties from the south are now in, except those of Assistant Hodgkins, who has been detained at Cape Lookout by bad weather, which has prevented his making a survey to show the changes in that locality, which, from casual observations and a partial report by Mr. Fairman Rodgers, are very great. This form of delay in work is common to all the government departments, first to one and then the other, when the proper committees fail to do their work promptly. Some delay may be justifiable under the conditions; but it is none the less injurious.

THE PLANTING AND EXHUMING OF A PRAYER.

IT may not be known to all the readers of *Science* that Mrs. Colonel Stevenson brought with her from New Mexico last autumn, Wa-Wah, a Zuñi woman, the most expert weaver and potter in her pueblo, and one of the five priestesses of the order of Ko-Ko.

For six months this woman has taught her patroness the language, myths, and arts of the Zuñis, — now explaining some intricate ceremony, at another time weaving belt or blanket under the eye of the camera, or with wonderful dignity and self-possession moving among the most enlightened society of the metropolis.

As the season of the summer solstice, or, more correctly, the summer moon, approached, Wa-Wah expressed the greatest anxiety to join with her distant people in the semi-annual plume-planting, the other festival occurring at the time of the winter moon. Letters were written to New Mexico, and the very day ascertained upon which the ceremony would take place in Zuñi (see accompanying plate, fig. 1).

Wa-Wah was all excitement to make her preparation of meal, sticks, paint, and feathers. All of these were abundant enough in the stores, but nothing of that kind would suffice. Various diplomatic schemes were tried, but her heart was fixed. The prayer must be right to infinitesimal particulars, or she would have nought to do with it.

Meal must be mixed with powdered shells and turquoise; the treasures of the national museum had to be opened; and the very pieces of yellow, blue, and black pigment collected in former years by the Bureau of ethnology must be laid under contribution for the stems of the sacred prayer-sticks. Mr. Ridgway's department of ornithology was invoked to supply feathers of the golden eagle (Aquila chrysaetos), the wild turkey (Meleagris mexicana), the mallard (Anas boschas), and the bluebird (Scialia arctica).

Fresh twigs from the cottonwood-trees were gathered for stems to the plumes. In the national museum are many boxes, said by the collectors to have been Zuñi plume-boxes (fig. 2), in which such treasures are kept. The plumes, which form the material instrument or accompaniment of the prayer we are describing, are made as follows: Take a straight piece of wood about the size of a lead-pencil and as long as the distance from the crease in the palm of the hand to the end of the middle finger. Make a slight incision around the stick near one end. Take a short stiff feather of the eagle, the turkey, the duck, and the bluebird, and one or two downy feathers of the eagle. Lay them together so that all the under sides will be toward the stick, and wrap their quill ends and the stick securely together with a cord made of native cotton, sufficiently long to leave free ends five or six inches in length after the tying. To these free ends tie another bunch of smaller feathers from the four kinds of birds (fig. 3). The upright feathers indicate the prayer as addressed to the sun, moon, and Ko-Ko; the trailing feathers, that the suppliant asks for help to walk in the straight path of Zuñi morality.

Ten plumes were thus finished on Friday, June 18, and dedicated to the several spiritual powers by painting the stems as follows: —

1. *Sun-plume.* — Blue stem; feathers of eagle, duck, and bluebird on stem and streamer; 2. *Moon-plume.* — Yellow stem; feathers of eagle, duck, and bluebird on stem and streamer; 3 – 6. *Ko-Ko plumes.* — Black stems; feathers of eagle, turkey, duck, and bluebird on stem or streamer; 7 – 10. *Ancestral plumes.* — Black stems; feathers of eagle, turkey, duck, and bluebird on stem or streamer.

On Saturday, June 19, at two o'clock in the afternoon, in a retired garden in Washington, Wa-Wah performed the ceremony of planting the plumes. Her time was arranged so as to act simultaneously with her people at Zuñi.

A hole was dug six inches square and fourteen inches deep, three inches of loose earth being left in the bottom. Around the top for a foot or more the surface dirt was smoothed like a garden-bed. Meal mixed with powdered shells and turquoise was sprinkled freely about and in the hole. Wa-Wah, arranged in her best attire, holding all of her plumes in her left hand, kneeled by the excavation (fig. 4). Taking the sun-plume in her right hand, she prayed for the good influences of the sun upon herself, her people, the crops, and her friends, and then forced the blue stem into the loose dirt of the cavity on the extreme west side, the inner sides of the feathers toward the east. The prayer continuing, the moon-plume, then the four Ko-Ko plumes, and lastly the four ancestral plumes, were planted in order, all with feathers inclining eastward.

Wa-Wah then arose, drew forth her little bag of sacred meal, poured a small quantity into her own hand and that of each of her two friends, who were watching with the deepest interest. Each, in turn, sprinkled the meal over the shrine, blowing gently with the breath (fig 5).

The utmost sincerity manifested itself in every portion of this ceremony. It seemed to those who gazed in rapt silence at this simple devotion, that they were witnesses to the surviving worship of the primeval world.

It was necessary that the sunlight should look upon this prayer during the rest of the day; therefore every precaution was taken to protect the place from intrusion.

On Monday morning, with the consent of Wa-Wah, the prayer-plumes, and the earth containing them, were carefully dug up, without disturbing a feather (fig. 6), and deposited in the national museum, perhaps the most unique object ever placed among its precious collections.

This ceremony has been carefully studied among the Zuñis by Mr. Frank Cushing and Mrs. Stevenson, and among the Navajos by Dr. Washington Matthews, all of whom will give more detailed descriptions, with translations of the prayers, in the future reports of the Bureau of ethnology.

O. T. MASON.

U. S. national museum.

CAN ECONOMISTS AGREE UPON THE BASIS OF THEIR TEACHINGS?

ONE of the first and most obvious tests by which to determine whether men possess exact and reliable knowledge of a subject should be afforded by the agreement or disagreement of its recognized cultivators. I propose to show in the present paper that there is no sound reason why political economy should not favorably pass such a test. It is true that its cultivators differ both in the methods and objects of their studies. But such differences do not imply difference of views respecting either fundamental principles or conclusions.

Let us illustrate this by the case of physics. We have some writers and teachers of physics who prefer the experimental method. They teach principles by experiments, and lay little stress on mathematical deduction. Others teach the leading branches of the subject by mathematical reasoning, clothing their results in formulae and theorems.

But these two classes of teachers do not stand in any antagonism to each other, nor accuse each other of ignorance. Each class recognizes the fact that there can be no diversity between correct theory and experimental results, and gives the other credit for aiming at truth in his own way. It is very clear to them that they are viewing and approaching the same subject from different points.

So, also, there are some economists who lay most stress upon the general principles of the science and the conclusions to be deductively obtained from them. Others prefer to lay stress upon the observed facts of society and business, showing the student how to work out such theories as may be founded on the facts he observes.

But it is an unpleasant fact that these two classes of teachers do not, like their brethren the physicists, mutually recognize each other as seeking and reaching valuable truths by different ways. Their attitude toward each other resembles that of the mediaeval philosophers more than that of the modern scientists. They divide themselves into 'schools,' each of which seems very unwilling to admit any truth in the system of the other. I hold that this state of things is a great drawback to the character and usefulness of economic science, and propose to inquire whether there is any necessity for its existence.

Since we must agree upon a common end, I shall assume such end to be the improvement of society, either by promoting such public measures and social movements as tend in that direction, or by discouraging and repressing those which tend to injure society. It is true that this is viewing the subject as an art and a policy rather than a science, and, in fact, taking a stand-point which detracts from its scientific dignity. But I am careful to say that this practical end is not the immediate subject which concerns us, but only the ultimate object which we may have in view.

Admitting, then, that a student desires to know what measures will benefit society, and what measures will injure it, how shall he proceed in acquiring that knowledge? I reply, he must be able to trace beneficial and injurious causes to their effects upon the social organism. If the knights of labor tell him that they want him to favor an eight-hour law, he wants to foresee what effect such a law will have on the interest of all concerned, — wage-workers, mechanics, men out of employment, and capitalists. So, also, when two opposing parties want him to vote for or against the coinage of silver, he cannot reach any intelligent conclusion unless he can foresee what effect free coinage or a cessation of coinage will have upon industry, commerce, and wealth. In a word, society being an extremely complicated and delicate organism, he must know what effects different causes may have upon it.

How shall he prepare himself for this great problem? I answer, that he must prepare himself as he would in the case of any other organism or machine: he must begin by understanding the anatomy and physiology of the social organism in its minutest details. Especially must he understand to what forces it is subjected, and what influence these forces have upon its workings.

Possibly we may here be met with the assertion that this is not a subject on which any exact knowledge can be acquired. There are respectable people, even teachers of economics, who seem to deny that they are dealing with a science. All

we can say in reply is, that this arises either from misapprehending what a science is, or from contemning the subject as unworthy of study. Science consists very largely in the establishment of exact relations between cause and effect, and a subject in which such a relation cannot be traced is unworthy of serious study as a science. In a word, if we admit that we can trace the relation of cause and effect, then we admit ourselves to be dealing with a science. If we do not admit this, then it is of no use to talk about questions of economic policy, and the safest course is to frown upon all social movements as productive of results which no man can foresee, and which are as likely to do harm as good.

The next question which arises is, how shall we proceed to acquire the necessary knowledge of society, — by purely deductive processes from general principles, or by the study of the facts as developed by history and statistics? I reply, we can attain no result except by a judicious combination of both processes. Some questions can be settled conclusively by common-sense deduction, while others are about matters of fact, and can be settled only by a study of facts. If a proposition were before the people of New York to withdraw water from the Croton Lake for industrial uses, and if the promoters of the scheme should publish an historical investigation of the phenomena of all aqueducts from the time of Caesar until now, to show that the withdrawal of the water would increase the available supply in New York, everybody would laugh at them. So in economics. No study of facts will tell us whether the number of houses available for a community will be increased or diminished by restricting the number of men who shall be allowed to learn the arts of carpentry and brick-laying, and by diminishing their hours of labor. But common sense settles the question at once.

If asked whether the most urgent want of the student is a knowledge of facts, or the practice of deduction and the study of deductive methods, I should reply that neither was urgent. What is really urgent is, that he shall know how to study facts effectively, and be able to understand principles rationally. The prevailing defect of the times is too much reliance on deduction, and too little understanding how to study the facts of the social organism, and how to apply principles to the study. What all economists should agree upon in their teaching, is to emphasize both the understanding of principles and the investigation of facts.

I have in my mind's eye two ideal men. The one has at his fingers' ends the state of commerce and trade the world over, knows the amount of imports and exports of all nations, and has their laws of banking and currency learned off by heart, but, with all this knowledge, does not understand the laws of supply and demand, nor see any reason why there should be a relation between the imports and exports of a country. The other ideal man has a clear understanding of the laws of supply and demand, and all other abstract principles of economics, but is absolutely ignorant of the actual condition of trade and commerce in any part of the world. Which man is better equipped to answer an economic question? I reply, that, taking them as they stand, neither is well equipped. But the second man has this advantage over the first, — that, when the question is presented to him, he will know how to investigate it, and, with the aid of better informed men, will be able to find out the essential facts for himself; while the other man will never be able to make any really valuable use of his knowledge. Hence I prefer a system of instruction which is more concerned in teaching the student how to think and investigate, than in storing his mind with facts.

Simon Newcomb.

GEOGRAPHICAL NOTES.

The Kongo. — The steam-launch Peace, belonging to the English missionaries on the Kongo, has been busily engaged, since her arrival on the river, in geographical work. Among the voyages made and reported by the Rev. G. Grenfell are a reconnaissance of the Kassai or Quango to longitude 17° 30′ East Greenwich. Another journey included a visit to the Lomami and Ikelemba, affluents of the left bank, and several others of the right bank, among them the Nkemfe, which proved narrow and tortuous. The Mobangi was navigable as far as explored; the Itimbiri also as far as the Lobi Falls, in 23° 28′ east longitude and 1° 50′ north latitude. At three or four miles from the junction of the Mbura with the Kongo, the former was found to divide into two branches, both barred by rapids or falls, the south branch having a cataract forty feet high. The Lomami is a fine river; but the current is very swift and the channel tortuous, so that the launch could make good but some six miles a day during the latter part of their stay upon it. In August of last year the Lulongo was ascended to a distance of nearly seven hundred miles. Its principal affluent is the Lopori, in 1° 12′ north latitude. Stanley's Black River, which enters the Kongo near the equator, is formed by the junction of the Juapa and Bosira. Hostile tribes forced the explorers to retreat after exploring the former some three hundred miles, when it was still navigable. The Bosira was only navigable for

about two-thirds that distance. Careful astronomical observations were made, and the final reduction of the many results obtained will greatly ameliorate the charts of the Kongo basin. The Rev. Mr. Grenfell insists upon the richness of the upper Kongo basin, and especially of the Kassai valley, and reiterates the opinion expressed by others, that a railway across the arid region of the lower Kongo is the only means by which commerce can be assured an entrance into this vast and fertile region.

Trade-route to Bolivia. — Information from Buenos Ayres indicates that Thouar departed thence for the upper river last February, and expected to reach Tarija early in April. He was to ascend the Pilcomayo with a Bolivian escort on a steamer of two hundred tons detailed for the purpose. It is hoped that the explorations now in progress will result in a permanent route for the commerce of eastern Bolivia toward the Atlantic. M. Thouar's health continued good, though fever was very prevalent: he attributes his exemption, at least in part, to the use of fumigations of sulphur.

Lake Moeris. — Mr. Cope Whitehouse, who has been investigating the supposed site of Lake Moeris in the Raian basin, writes, that, assisted by Herr Stadler, a government engineer, and his party, a line of levels has been run between the canal of Gharak, connecting with the Nile, and the margin of the depression. At a point twelve metres from the level of the Mediterranean a bench-mark was established, and a sketch of the whole basin made. The ruins of the Wadi Moelleh are supposed by Mr. Whitehouse to be those of Dionisian placed by Ptolemy on a long and narrow arm of Lake Moeris. Col. Scott Moncrieff, director of public works, will have made a general plan and estimates for a canal, to fill the basin from the Nile, as soon as the hot season is over. The Mussulmans regard the project favorably, as they have a tradition that Lake Moeris was established by the patriarch Joseph, the Bahr Jussuf still retaining his name. It would result from these works that at high Nile an area of six hundred square kilometres could be covered to a depth of eighty or ninety metres, capable of doubling the volume of the low Nile, and of rendering an immense extent of now desert ground susceptible of cultivation.

The spring in Alaska. — The spring in Alaska has been unusually late and cold, with exceptional precipitation. A large number of prospectors have crossed over the divide to the British head waters of the Yukon, in search of the rich diggings found by a lucky few last year. Many of them are doubtless doomed to severe disappointment. The fishing-fleet has already sailed from San Francisco, consisting of eleven vessels, of 2,331 tons, manned by 273 men. Four of the vessels fish in the Okhotsk Sea; the remainder, in Alaskan waters.

PARIS LETTER.

PROFESSOR DE LACAZE-DUTHIERS, whose name is familiar to all zoölogists, owing to many very good contributions to the biological sciences, has, after a rather severe illness which kept him confined to his room for more than three months, resumed his yearly task, and begun his lectures. As usual, his opening address was devoted to a general summing-up of what work has been done in his laboratory during the past year; but this time, instead of a short summary, he delivered a lengthy address concerning his seventeen-years' task as a professor of zoölogy in the Sorbonne.

M. de Lacaze-Duthiers was appointed in 1869. Professor Milne-Edwards being then professor of comparative anatomy, M. de Lacaze-Duthiers had to undertake the teaching of zoölogy proper; which he did, it must be said, with a great deal of talent and energy. He understood very well that zoölogy can be taught only in part, and that the greater part of that science the student must learn by himself alone, without tuition, by practice and experience under the direction of his teacher. In order to give students all possible aid, he undertook to found a marine biological station on the Brittany coast. With the aid of government, he began the laboratory of Roscoff in 1872, and thus accomplished a very useful work. I visited this laboratory some two or three years ago, and spent there a month or so in scientific pursuits. It is very well organized and directed.

Roscoff is a little town, or rather a big village, near Morlaix, where a few people come to spend the summer season, for sea-bathing, and where there is nothing to prevent a good time of hard work, since the only diversion to be had is work itself. The inmates of the laboratory, who are allowed to spend their time as they please, with Professor de Lacaze-Duthiers's consent, live in the laboratory itself. Each has his sleeping-room. Some work in their sleeping-rooms; others, in two or three big rooms fixed up for working purposes, and representing real zoölogical laboratories. A library and a parlor are for general use; an aquarium, with a number of tanks, contains the rare or curious species of the coast; there is also a collection of preserved specimens, which will be used some day to build up a fauna of the Roscoff coast.

Roscoff receives a good number of students who

are preparing their *licence-ès-sciences:* the other visitors are either licentiates who are preparing their doctorate theses, or doctors who are pursuing new researches. The fauna is very rich, and the species are numerous. The tides being very high, there is a good deal to be found at low water, under the rocks, or in the pools. The laboratory is open from May to October.

In 1881, Professor de Lacaze-Duthiers began forming another laboratory, a winter one, on the Mediterranean coast. This is the laboratory Arago of Banyuls, close to the Spanish frontier. The state had little to do with the establishment of this laboratory: Professor de Lacaze-Duthiers preferred asking money right and left, of the municipal boards, of the towns of Perpignan, Banyuls, etc., and succeeded in getting money enough to build a very commodious laboratory in a very short time. Having been an inmate of this laboratory during a whole winter season, — the Banyuls laboratory is open from November to June, — I am qualified to speak of it; and it must be said that the organization is a very good one.

As there is no tide in the Mediterranean, the animals are fetched by two or three boats belonging to the laboratory: they are furnished with all the necessary implements, and have a crew of four men. Those of Roscoff need only two or three sailors.

At Banyuls the persons who work in the laboratory do not live in it: each has his working-room, but one must lodge and board in the village, where good enough accommodations can be found. I had there a whole house, with accommodations for five persons, at the rate of twelve dollars a month. Living is cheap; and I can say from personal experience, that, for a biological student, nothing can be pleasanter than a season at Banyuls, where the climate is generally fine, and the scenery very pretty, looking out on the blue Mediterranean.

The laboratory comprises an aquarium, with tanks full of pretty and curious specimens of marine life, a library, a collection of preserved specimens, and accommodations for twenty-five persons. There are three boats and one life-preserver. Although the fauna is not as rich as it is in Roscoff, the animals are numerous. The Medusae, Siphonophora, and many other Coelenterata are especially pretty, and on some days are to be found in enormous numbers. The laboratory of Banyuls is especially reserved for students who have already taken their degree of licentiate, and are preparing a thesis, or for scientists who wish to study some zoölogical questions; but it is not open to beginners, to persons who have not yet had practical experience in zoölogy.

After having founded his first laboratory, that of Roscoff, Professor de Lacaze-Duthiers founded, in 1872, his *Archives de zoologie expérimentale et générale*, so as to be able to publish the works of his pupils and of the persons who come to his laboratories. This paper has succeeded so well, that it is at present overcrowded, and cannot accept all that is proposed for publication.

These results show that Professor de Lacaze-Duthiers's first seventeen years in the Sorbonne have been very useful to zoölogy, especially if one considers the number of papers he has published, and the number of pupils he has had, and has yet.

In consequence of Milne-Edwards's death, Professor de Lacaze-Duthiers has taken the professorship of comparative anatomy: that of zoölogy has been given to one of his best pupils, M. Delage. It is to be hoped that M. de Lacaze-Duthiers will be able to continue a long time making himself useful to science. The students, on hearing his address some days ago concerning his past work, all concurred in this feeling, and made it known by very liberal and hearty cheers.

In one of my last letters I spoke about the great services rendered by photography in the recent caving-in of a quarry near Périgueux. MM. Langlois and Siemens have continued taking photographs of the yet buried victims, and have disclosed new facts. The photographs, taken in the way I have already explained, show three corpses, of which one was immediately and easily recognized; another is supposed to be a man who was in the quarry at the time of the accident; the third is unknown. These photographs not only show all the tools and implements the victims had with them, such as saws, planks of wood, a cart, etc., but they also show that the unfortunate men must have lived some time, since one of them, who always wore short-cut hair, is seen on the photograph to have very long locks. It is certain that these men lived some time, and that the smoke perceived some days after the accident was due to their having built a fire to warm themselves or to do some cooking. The public feeling is very much excited against the directors of the quarry for not having earnestly tried to get at the victim when it might still have been useful.

At the last meeting of the Société de psychologie physiologique a good many strange facts were made known by different persons, concerning instances of somnambulic sleep induced at a distance. It would seem that certain persons are able to induce sleep in a subject, Madame B., by pure mental operation, by willing it, at a distance of some hundred yards. The fact is a very interesting one; but it seems that it would be better,

before trying to explain it, as some would like to, to see if the fact is real and positive. The persons who have witnessed it are certainly very trustworthy, but this is no guaranty that they had all the requisites for experimenting in a satisfactory manner. Deceitfulness is so frequent in persons of hysterical nature, and experimenting is so difficult, as the Hippocratic aphorism says, that such questions ought to be studied only by professional experimenters. One may be a sound philosopher or a good physician, and yet understand nothing about experimenting. As for medical students, their authority in such matters is of little worth. The society ought to appoint a committee to investigate the matters brought forward, and select some professional experimenters of a sceptical turn of mind, and somewhat more incredulous than are most of the persons who study, or pretend to study, somnambulic phenomena.

At the meeting of May 17 of the Academy of sciences, the academy presented M. Chevreul, the veteran of French science, with a very fine gift, in commemoration of his hundredth year. As he came into the room, the whole assembly rose, and the president, Admiral Jurien de la Gravière, made a little speech, in which he very appropriately remarked "that what we honor and celebrate in your green and majestic old age is not, to be sure, the length of your life: it is, above all, the good use you have made of this exceptional favor of Providence." The gift made to M. Chevreul consists of a bronze by Dubois, representing 'Study and meditation.' It is allegorical, and does not at all represent M. Chevreul's features, which, it must be said, are not particularly handsome. M. Chevreul answered briefly and in very feeling terms. It is in August that M. Chevreul's hundredth year will close. It had been decided that it was better to anticipate the anniversary some weeks, because in August many members of the academy are out of Paris, taking some rest, or travelling, and because postponing is rather dangerous with a centenarian.

Dr. Worms has recently made known to the Academy of medicine the results of his investigations concerning Daltonism and other sorts of color-blindness among the *personnel* of the Northern railway. The number of persons examined is 11,173, and the proportion of defective color-vision is a very small one. Two persons only were utterly incapable of distinguishing one color from another; three were color-blind for red; six for green; eighteen mistook green for red; fifteen could not distinguish green from blue or gray; fifty-two had a certain weakness in color-vision. Upon the whole, the defects of color-vision are very scarce among the persons examined by M. Worms; and there is not much danger to be feared for railroad travellers from these defects.

M. Balbiani, professor in the Collége de France, published some days ago, in the *Revue scientifique*, an interesting paper on viviparous fishes, in answer to a letter written by a person of New Orleans concerning a viviparous ray. It seems, from the letter, that this fish is very much disliked by fishermen, not only because it is viviparous, and so differs from other fishes, but because it seems also to have menses, like mammalia. Professor Balbiani contributes an interesting note on the subject, and explains in a very acceptable manner the appearance which so much troubles the New Orleans fishermen.

Among the recent publications of scientific interest, we may notice Professor Cornil's second edition of 'Les bacteries.' This book is a very good one, and the first edition was sold in a few months, so that a second has become necessary. Professor Cornil has added many new facts concerning bacteriology, and his book is more valuable than ever.

Professor Herzen of Lausanne has published a little work on digestion. He entirely confirms Schiff's theory of peptogenes, and shows how well conducted have been this physiologist's experiments. Professor Herzen was able to examine a man with a gastric fistula for some time, and has made very useful experiments concerning the therapeutics of dyspepsia. He shows how this disease ought to be treated, rationally, and his book is of practical as well as of scientific interest.

We may also notice the second edition of Professor Bouchard's 'Maladies dues au ralentissement de la nutrition' ('Diseases due to retardation of nutrition'). This book is always full of suggestive facts, and deserves the fame it has enjoyed since the day it came out.

M. Miquel, the well-known micrographer, recently read at the meeting of the Société de médecine publique, a paper on horal variations of aerial bacteria. There is a sort of tide with high and low water marks in the distribution of these micro-organisms. There is a first high-water between six and nine A.M., and a second from six to eight P.M. The minima are at two P.M. and two A.M. These differences are also perceived in open rooms, but not in closed apartments. The inference is, that it is better to ventilate rooms from eleven in the evening to five in the morning; but this is not always very easy and practical.

Some days ago M. Denika, a pupil of Professor de Lacaze-Duthiers, published a very interesting thesis on the structure of a gorilla embryo, studying all the particulars of the different systems of

the body, and establishing an interesting comparison with the organization of other monkeys. This gorilla embryo is the first that has been dissected yet, and studied with real care.

A new publication was started some time ago in Paris. It is the 'Grande encyclopédie,'—a cyclopaedia in which all facts at present known concerning science, literature, arts, legislation, etc., are condensed; it is a summary of present knowledge. The first volume is now ready. The whole publication will comprise some twenty or twenty-five quarto volumes. It is written by a number of contributors, and only by specialists, under the direction of a committee comprising MM. Berthelot, Hahn, Levasseur, Laisant, Marion, etc. It seems to be a very good idea; and, although the 'Grande encyclopédie' does not pretend to create the furor that Diderot and d'Alembert's did, from a philosophical point of view, it certainly will be of great use, if it continues as it has begun, being very complete and well prepared. There are no such cyclopaedias in France yet, written by competent persons; and there is no doubt that this publication really meets a general demand. It is printed with great care, and most of the articles are made up from the latest and best documents. It is to be expected that the public will look on it favorably, if it continues as it has begun, and if the contributors are always well chosen by the directing committee. It is time that France should have a cyclopaedia able to stand a comparison with those of England and of America.

At a recent meeting of the Academy of sciences, M. d'Arsonval presented a very well combined instrument devised for the investigation of the duration of different psychical or physiological phenomena. It is very useful, for instance, for the study of reaction-time, of perception-periods, and for the study of the dilemma-time in distinguishing two or more perceptions. The great advantage of this instrument is, that it disposes of the estimation of the experimenter himself, and gives much more exact results in the very delicate and difficult estimation of the duration of mental phenomena. M. d'Arsonval is a very able man in all that concerns mechanical contrivances; and his instrument, which I saw at the works of Ch. Verdin (the constructor) some days ago, is a very well contrived one. V.

Paris, June 15.

NOTES AND NEWS.

CONGRESSMAN VIELE of New York made a strong effort in the house last week to secure an appropriation of ten thousand dollars to continue the National board of health. Representative Randall declared that there was no need for a national board of health, and the house seemed to coincide with him, for the item proposed by General Viele was not adopted.

— Dr. C. H. F. Peters, of the Litchfield observatory of Hamilton college, discovered on the night of the 28th of June a new asteroid of the eleventh magnitude: its number will be 259. Number 258 has been named Tyche.

— The organizing committee of Section A of the British association has arranged that a special discussion shall be held, jointly with Section D, on the physical and physiological theories of color-vision. The discussion will be opened by Lord Rayleigh, and Dr. Michael Foster will also take part in it. Persons who wish to contribute papers bearing on the subject of discussion are requested to send their names to the recorders of Sections A or D, at 22 Albemarle Street, W., not later than Aug. 1.

— 'Consanguinity in marriage' was the subject of an address by Dr. McKee at a recent meeting of the Ohio state medical society. The belief that consanguineous marriages are followed by evil effects upon the offspring is not accepted by the author, and the object of his address was to show its falsity. A very interesting and concise account is given of the Mosaic law, and also of that of the Greeks and Romans, in reference to the marriages between relations; and full quotations are made from the statistics of modern writers and observers. Among the eighteen conclusions drawn as the result of the author's studies are the following: 1. Like breeds like, good or bad, entirely independent of consanguinity. 2. Intemperance, luxury, dissipation, sloth, and shiftlessness, as well as hygienic surroundings and innumerable other causes, should bear much of the responsibility laid at the door of consanguinity. 3. Data are of doubtful reliability, full of flaws and false reasoning. The noted cases are the unfortunate ones. The favorable are unknown or forgotten. It is the ill news which travels fast and far. 4. Statistics show about the same proportion of deaf-mutes, idiots, and insane persons, descendant from consanguineous marriages, to the whole number of those unfortunates, as the number of consanguineous marriages is to the whole number of marriages. 5. Consanguineous marriages which bring together persons having a disease or morbid tendency in common are dangerous to the offspring; not, however, one whit more so than the marriage of any other two persons not related, yet having an equal amount of tendency to disease in common. 6. The half a hundred abnormalities ascribed to consanguinity, including almost all

the ills that flesh is heir to, — among others, whooping-cough, — approaches the ludicrous. 7. Consanguineous marriages, no other objection being present, should not be opposed on physiological grounds. The address closes with an exhaustive bibliography of the subject, including some thirty writers, and extending, in point of time, from Moses to the present year.

— A French journal cites the fact that a number of persons have recently been poisoned in France by eating asparagus grown in localities where small amounts of sulphide of carbon existed in the soil. The symptoms were those of cramps and diarrhoea.

— Rumination is commonly supposed to be a digestive process peculiar to certain of the lower animals. There are, however, some forty cases on record where this power has been possessed by members of the human species. It usually commences so soon after birth that the affected individual cannot state its commencement, and appears to be present in males almost exclusively. It is in all its steps essentially the same as in the ruminating animals, and, as it mostly occurs in those who are large eaters, it is evidently one of nature's methods to provide for more thorough mastication in those who eat to excess, or do not take the necessary time to masticate their food properly in the first instance.

— The Boat-sailer's manual, by E. F. Qualtrough, U. S. N. (New York, *Scribner*, 1886, 24°), deserves and should command a ready sale among the many whose interest in the subject is awakened or revived by the triumphs of the Puritan or Priscilla. There is a great deal of information in it, most germane to the subject and very well arranged. The language is, however, unintelligible to the general reader; and the glossaries, of which there are two, are quite defective. They should be consolidated, to save the trouble of two searches, and even then there are forty-two words unknown ashore, used by the author and not defined.

— The annual report of the astronomer royal, Mr. Christie, was submitted to the Board of visitors of the Greenwich observatory on June 5, and gives an account of the progress and activity of the observatory for the year ending May 20, 1886. Copies of the original report have not yet reached this country, but the following particulars of its contents have been obtained from abstracts which have been published in *The Athenaeum* and *Nature*. The regular work of the transit circle and the altazimuth has been continued, and very satisfactory results have been obtained with the apparatus for determining absolute personal equations brought into use with the former instrument some months ago. Spectroscopic observations include a considerable number made of the new star which burst out last August in the great nebula of Andromeda. The spectroscopic observations of Sirius indicate, as in the last three years, a displacement of the F line towards the blue: this displacement would correspond to a motion of the earth towards Sirius at a rate of something more than twenty miles per second, though, from the nature of the observations, the amount of such a motion cannot be considered as very accurately determined. For the year 1885, a photographic record of the sun's surface can be made out for 360 days by filling up the gaps in the series of Greenwich photographs from photographs obtained in India and the Mauritius. Observations of comets and of casual phenomena have been made with the equatorials; and the magnetic and meteorological observations, the time-service, etc., have been kept up as in previous years. The full import of the statement that the reductions of the observations are keeping pace with their registration, will be appreciated by all who are engaged in routine astronomical work. In regard to the new equatorial, Mr. Christie says, "The construction of an object-glass of 28 inches aperture and of 28 inches focal length, with suitable tube, to be mounted on the south-east equatorial, has been authorized by the government, and the necessary funds have been provided in the estimates. The work has been intrusted to Mr. Grubb, with whom I have arranged the details of the tube, which is to be of special construction, adapted to the conditions of the mountings, and available for spectroscopy and photography as well as for eye observations. Mr. Grubb proposes to provide means for readily separating the lenses of the object-glass to such a distance as will give the proper correction for photographic rays."

— In connection with the recent notice of Professor Hull's 'Report on the geology of Palestine,' it has recently been stated (*Geol. mag. Lond.*, September, 1884) that Dr. Schweinfurth, the well-known African explorer, has recently announced the discovery of paleozoic fossils in the Wady Arabah, west of the Gulf of Suez, in sandstone hitherto regarded as Nubian sandstone. The fossils have been submitted to Professor Beyrich, who identifies a species of Spirigera or Athyris, allied to A. concentrica, and stems of crinoids. The exposure seems to be not dissimilar from that of the Wady Narb on the other side of the Red Sea. Dr. Schweinfurth's paper is in the Bulletin

of the Egyptian institute for 1885 (Cairo, 1886). This discovery confirms the suggestion of Sir William Dawson as to the carboniferous age of the lower part of the Nubian sandstone of Egypt, based on a fossil plant and on its geological relations.

— The human spleen has been removed seven times in Italy, and in but two instances has the patient recovered. Prof. Antonio Ceci of Genoa has recently performed the operation, and his is one of the two successful cases. The patient was a poor girl, seventeen years of age, and the enlarged spleen weighed one-fifteenth of her entire bodily weight.

— Malignant pustule is fortunately of very rare occurrence. A patient suffering from this disease has recently died in Guy's Hospital, London. He was employed on a wharf, in the handling of foreign hides, and undoubtedly contracted the disease from the hide of an animal which had been affected with the disease known by the French as charbon, by the Germans as milzbrand, but by English-speaking people as anthrax. The patient noticed a pimple on the back of his neck, which in twenty-four hours became greatly enlarged, and the glands of the neck were swollen. The surgeons removed the enlarged pimple at once, but without avail, the man dying in about four days from the time he first noticed the pimple. This disease may also be contracted by the bite of an insect, a fly for instance, which has been feeding upon the carcass of an infected animal. The microbe of the disease is a bacillus (Bacillus anthracis), and was observed in the blood of cattle as long ago as 1849 by Pollender, although its importance was first recognized by Davaine in 1850.

— The evidence of the greater safety of ether than chloroform as an anaesthetic is accumulating very rapidly. In England during 1885 there were twelve deaths attributable to chloroform, and but three to ether.

— Physicians are now using aniline-oil as a local anaesthetic when simple operations, such as the opening of a felon, are to be performed. The finger, in such a case, is dipped for a short time in the oil, and, although the flesh may subsequently be cut to the bone, it is said there is absolutely no pain.

— We learn from the *Sidereal messenger* for July that the contract for mounting the 36-inch objective has been awarded by the Lick trustees to Warner and Swasey of Cleveland, O., for $42,000. The telescope is to be fifty-seven feet long; the diameter of the tube, forty-two inches. Provisions are made by which it will be possible for the observer at the eye-end of the telescope to command all the possible motions, and these same motions can also be controlled by an observer stationed on a small balcony twenty feet above the floor. It is expected that the mounting will be completed in April, 1887, and that the glass will be brought to Mount Hamilton and put in place some time during the summer following. The total cost of the equatorial and dome will be about $164,850; the cost of the dome being $56,-850; the mounting, $42,000; the visual objective, $53,000; the additional photographic lens, $13,000.

— Mr. H. C. Wilson, assistant astronomer at the Cincinnati observatory, has accepted a position as computer under the Transit of Venus commission in Washington.

— The 'Atlantic pilot chart' for July calls attention to the necessity for the establishment of a simple international code, by means of which passing ships can indicate readily and exactly the points where they have encountered ice. Many systems have been proposed, but that copyrighted by Mr. F. Wyneken of New York seems to be the best yet offered, and has been adopted by many transatlantic steamer companies according to the chart.

— MM. Regnard and Loye recently made some investigations of interest on the body of a criminal who died under the guillotine. For physiological research the authorities arranged that possession should be given instantly after the execution. Immediately after the decapitation a temporary rigor of the whole muscular system took place. In lifting the body by the heels the whole frame was moved, and remained absolutely rigid and inflexible. Even the eyelids could hardly be forced open. Not a tremor of any sort was discernible. This state lasted between two and three minutes. At three minutes from decapitation voluntary reflex action had completely disappeared. Irritation of the soles of the feet, of the conjunctiva, of the spinal marrow, produced no effect. Only the pupils contracted slightly before a bright light. The first experiment was to determine the action of the pneumogastric nerve on pulmonary contractility. The investigations of Williams and Paul Bert have shown that in the dog the circular muscular fibres surrounding the bronchia are innervated from the vagus. But in the dog the pneumogastric is so intimately connected with the sympathetic, that it is difficult to determine to which of these nerves the action of the muscles of the lung should be ascribed. In man they are separated. In the present case the result of the experiment showed clearly that the action of the pneumogastric determined the contraction of the lung by the contraction of the circular fibres.

Forty-five minutes after decapitation the intestines were perfectly free from motion, and the access of air to the abdominal cavity did not excite it. On excitation of the two vagus nerves, movement of the stomach and intestines was very evident, extending as far as the transverse colon. Longet had supposed that this action of the stomach took place only when it was filled, but in the present case it was entirely empty. On re-excitation, the walls of the stomach folded in plications, and drops of gastric fluid were visible over almost the whole of its surface. The heart beat at the rate of fifty-one pulsations per minute twelve minutes after execution: it ceased entirely at the end of the twentieth minute. These experiments bring nothing unexpected, but they give final confirmation to theories hitherto based only on vivisection of animals, and extended to man by hypothesis. They may also re-assure those physiologists who have feared that conscious life might exist after decapitation by the guillotine.

— The utilization of scrap tin has exercised the minds of many inventors who have seen a fortune in it, if they could only separate the covering metal from the sheet of iron beneath it. It is estimated, says *Engineering*, that the supply of old and scrap tin at London, Birmingham, Swansea, Wolverhampton, Truro, Liverpool, and Glasgow, amounts to 30,000 tons per year, and that this can be obtained at 5s. per ton, or less. Of this weight, five per cent is pure tin, which, in ingot form, is worth £95 to £100 per ton; while the iron, separated from the tin, is worth about 40s. per ton. Hence 20 tons of scrap, which can be bought for £5, would realize, when the two metals are separated, at least £130, a sum which allows a very good margin to cover the cost of the manufacturing operations. A company, called the Electro metal extracting, refining, and plating company, of 76 Finsbury Pavement, E.C., has been formed to carry out a new process by which the tin is stripped from the iron in a perfectly pure form, while the foundation plate is unattacked. The scrap is placed in a series of baths, through which a current from a dynamo is sent; and while there the white metal is dissolved, and is afterwards recovered in metallic state. It is said that the operations are so inexpensive that a profit of £79 is realized from the treatment of every 20 tons of scrap. The process is also set forth as being applicable to mining refuse, tailings, and slags containing gold, silver, copper, tin, etc., as well as to plating metals with zinc.

— All of the original coast survey plain table sheets of the water-front of New York, Brooklyn, and Jersey City, have been published by photo-lithography on the full scale of the surveys, and are now ready for use. A chart has been prepared, and is now ready for publication, which will fill a long-felt want by supplying in one sheet all of the waters of Washington Territory north of Gray's Harbor. This chart covers the coast from Tacoma to Nanimo.

— Professor Baird and the usual complement of officials composing the summer force of the fish commission left Washington on Tuesday last, July 6, for Wood's Holl, Mass., to be absent till October.

— The second number of the *Political science quarterly*, edited by the faculty of political science of Columbia college, contains the following articles: Andrew Jackson, by Anson D. Morse; The Constitution in civil war, by William A. Dunning, Ph.D.; Ambiguous citizenship, by Hon. William L. Scruggs; The Christian socialist, by Edwin R. A. Seligman, Ph.D.; The legal tender question, by Harry Harmon Neill; Constitutional crisis in Norway, by Prof. John W. Burgess; The conflict in Egypt, I., by John Eliot Bowen, Ph.D.

— The passage of the Suez Canal, which until recently occupied from thirty-six to forty-eight hours, can be made, now that navigation during the night is possible, in sixteen hours for vessels fitted with the electric light apparatus. This important advance is the result of a very interesting report by Commander Hector, of the steamer Carthage, belonging to the Peninsular and oriental company, and addressed to the directors. This report was written after the Carthage made the first continuous passage, under the authorization of the Canal company, given the 1st of December, 1885. The Carthage arrived at Suez after a run from Port Said of eighteen hours. The actual running time was sixteen hours. there having been two delays caused by impediments in the channel: the mean speed made was 5.43 miles per hour. The passage as far as Ismailia was the most interesting, because it was the first attempt to take a large vessel through at night, with the aid of the electric light.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The new school of economists and the history of economics.

PERMIT me to make a correction of a misstatement, no doubt inadvertent, in Professor Ely's article in the last issue of *Science*, on the economic discussion. He says that the 'new school' of economists "were the first in America to give a proper position to Adam Smith, Ricardo, and Malthus, by the introduction of

courses in the history of political economy into our colleges." And yet, at least as early as 1878, and I believe for several years before that date, Professor Dunbar gave at Harvard university an advanced course in political economy, in which a large part of the time was occupied with a careful examination of the history and development of economic doctrines. The writings of Adam Smith, Ricardo, and Malthus were naturally given especial attention. The course of which this historical study was a part has continued to be given from year to year since it was first instituted. Other institutions may also have offered courses of the same kind; but certainly in this instance the history and literature of political economy were studied before the new school had entered the field.

There is a tendency in the new school to claim for itself perhaps an undue share of credit for the advances in economic thought and economic teaching which have taken place in the last ten or fifteen years,— a tendency which seems to me to be illustrated by Professor Ely's somewhat hasty remark.

F. W. TAUSSIG.

Newport, July 4.

Sea-level and ocean-currents.

In the number of *Science* of Jan. 1, I published some notes on the great equatorial westward flow of the earth's atmosphere and its influence upon oceanic circulation. I credited to this great atmospheric current the westward movement of the surface water of the ocean beneath it, and considered the friction of the winds as the most important factor in the whole system of oceanic circulation. In an interesting letter published in *Science* of Jan. 22, on sea-level and ocean-currents, Mr. William Ferrel states that the theory which attributes the movement of ocean-currents to the friction of the winds is untenable, saying, among other things, "that it is well known that ordinary winds have very little effect in changing sea-level except in very shallow water." He fortifies this assertion by quoting, from the report of the chief of engineers, observations which seem to show that the mean level of the water at either end of Lake Ontario varies but one-third of an inch with changes of wind; that the sea-level is precisely the same on both sides of the Isthmus of Darien; and that the sea-level on the coast of Ireland is the same in summer and winter, though the more violent westerly winds of winter should raise that level if winds were capable of moving and heaping up water on a coast.

Though fully appreciating the accuracy and value of Mr. Ferrel's work, and differing from so high authority with extreme reluctance, I deem it but justice to myself to say that the question is by no means so simple as he represents it, and that there are many facts which prove, beyond all argument, the power of wind to move great masses of water, and to produce all the phenomena of oceanic circulation. For example: for ten years I occupied in summer a country house on an island in Lake Erie, and I have more than once known a strong westerly wind to depress the level of the water in the west end of the lake, and raise it at Buffalo by two feet or more. This means the actual transfer, within a few hours, of a sheet of water of half the area of Lake Erie, and one foot in thickness, from the western to the eastern portion of the lake.

I was once detained at Indianola, Tex., three days by a norther, which blew the water off the coast till the harbor was almost dry land.

Again: since this discussion began, violent south-easterly gales have forced the ocean water into New York harbor, and raised the water-level six feet or more, inundating much of the lower portion of the city, and causing great destruction of property. As this rise was general along the coast, and was felt as sensibly at Sandy Hook as at the Battery, it is evident that we here have proof that wind is capable of moving vast bodies of water before it, even where the depth is considerable.

All the facts cited by Mr. Ferrel in support of his statement are of equivocal bearing on this question. The sea-level on the isthmus is still under discussion, and, if it shall be proved to be the same on both sides, that fact would be as difficult of explanation on the gravitation as the wind theory.

Capt. John Brown of Put-in-Bay Island reports to me that "a strong westerly wind sometimes depresses the water-level at Put-in-Bay four feet below the normal." And Mr. Julius Pohlman of Buffalo writes me as follows: "I learn from the records of the signal office here that the heaviest south-west storms on record raised the waters at this end of the lake between eight and nine feet above the ordinary level.

It is true that more violent winds are encountered on the Atlantic in winter than in summer, but almost none of these are continuous across the ocean. All the cyclones are rotary, and the storms not such are local and temporary. A change or reversal of direction of the wind would soon neutralize its effect, and in winter the antagonistic easterly winds are correspondingly violent on the European coast. On the whole, it is doubtful whether the sum of the impulses of the westerly wind is much greater in winter than in summer.

Since the atmosphere presses on the ocean with a weight of nearly fifteen pounds to the square inch, it is evident that when the air is moved the friction must be great. This is demonstrated by the rapid raising of ridges of water before a strong wind; and these ridges are all waves of translation. Waves of oscillation occur, but they are rare; and the apparatus so frequently employed for illustrating wave-motion by vertical rods successively lifted is misleading.

Mr. Ferrel says, in conclusion, "A continuous wind for some time in any direction causes merely surface currents of considerable velocity;" but it requires no argument to show that such surface currents, if continuous, would infallibly produce a movement of the deeper strata of water in the same direction.

The time estimated by Zöppritz for the transmission of surface motion to the depth of a hundred metres seems to me grossly exaggerated: but even if ten times longer than his estimates, the great equatorial wind, which has doubtless been blowing from east to west since the ocean has had an existence, would be amply sufficient to establish a movement that would form a *primum mobile* for the whole system of oceanic circulation.

That gravitation is a factor in oceanic circulation is proven by the presence of ice-cold water in the abysses of the ocean under the equator, — water that must have flowed in from the polar regions, — but it has seemed to me, and to many others whose opinions are worth more than mine, that it is a much

less important factor than wind-friction. Those interested in the subject will do well to read the chapters on ocean-currents in Croll's 'Climate and time,' and the papers by Croll and Carpenter in the London and Edinburgh *Philosophical journal*, and the Proceedings of the Royal society.

J. S. NEWBERRY.

Columbia college, July 1.

Private research and government science.

Since the promulgation and discussion of the bill to curtail the work of the scientific bureaus at Washington, and Mr. Herbert's appeal "to the best literary and scientific thought of the country to come to our aid and join us in the effort to effect a reform and arrest this pernicious tendency," much has been written and said upon this subject.

One of the chief arguments brought to bear by those opposed to the extraordinary scientific progress being made, and the vast amount of scientific work being done by this country at the seat of its government, is, that this work is proving detrimental to private research in similar channels.

Further, it has been said by the opposition that these scientific publications of the U. S. geological survey are valueless in the book-markets of the world; and Mr. Herbert points to that law in the organization of the survey which specifies that it shall sell all its publications not exchanged at cost, and that during the past six years this sale has realized an amount but slightly exceeding fifteen hundred dollars.

Now, one of the best proofs that this scientific activity on the part of the government is in no way checking private research, has been recently brought forward by Professor Agassiz, who laid before this commission of investigation the titles of forty-eight publications of the Museum of comparative zoölogy at Cambridge, alone.

But perhaps a still better light is thrown upon these two latter questions by an unprejudiced examination of such a catalogue as is published by Dulan & Co. of 37 Soho Square, London. Here we find five of Mr. O. G. Elliot's zoölogical monographs on sale for five hundred and forty-five dollars, and other evidences of the very highest activity in private research in America on every page. Moreover, to prove that the government publications of this country are not held as being valueless in the book markets of the world, we see any number of the publications of the geological survey, and other scientific bureaus of Washington, on sale in the above catalogue, and being sold at prices fully equalling those of private pulications. That more money has not been realized at the survey for the sale of its works, simply speaks in favor of how eagerly they are sought in exchange, leaving but a few copies each year on hand for sale.

The excellent handbooks of geology of this country by Dana and LeConte do not seem to have been suppressed by government interest in this highly important work; and if we run our eyes over the bibliography and illustrations of this science, as set forth in these two volumes, I defy any one to say that the government work is not appreciated, or that private researches in this field are checked. The same holds good for all the other sciences.

I think when the sense of the vote of the "best literary and scientific thought of this country" is taken upon Mr. Herbert's appeal to suppress such works as the paleontological monographs of Marsh, Ward, White, and others, and the magnificent publications in the bibliography of science undertaken and accurately carried through by our government, there will be an enormous zero on his side of the ticket. Government moneys can be squandered on far worse things in the times of peace, than such schemes as powerfully aid the progress of knowledge, culture, science, and learning. Be it said to the credit of this country that she sees fit to invest her surplus means to the advancement of such ends.

R. W. SHUFELDT.

Fort Wingate, N. Mex., June 29.

Expulsion theory of comets.

Mr. Proctor's article in a recent number of the *Nineteenth century*, on the expulsion theory of comets, leads one to believe that the solution of this problem is not only as far off as ever, but that little headway is being made for a general clearing-up of the 'mystery.' There are many serious objections to this particular theory of the origin of comets. We admit, of course, that the earth and Mars, for instance, or even the moon, may have been at one time scenes of vast fiery eruptions, etc. But that this cast-off matter should go out into space in a burning state, and continue to go out, probably, for a great number of years, then return, still in a burning state (the alleged comet),—while the body from which it was expelled, and a much greater size as a matter of course, always remaining in close proximity to the sun, and drawing closer all the time, should cool down and become solid and non-luminous, such as the earth, Mars, or the moon is at the present time,—is certainly something on which Mr. Proctor's theory throws little light. The expelled matter must naturally cool down the same as the body from which it was expelled, and except by accident, considering the distance it would have to travel to meet another source of heat (a sun), we can only come to one conclusion in regard to the expulsion theory, it won't do. G.

Brooklyn, June 29.

Flooding the Sahara.

Mr. G. W. Plympton's very interesting and suggestive article on the flooding of the Sahara (*Science*, vol. vii. pp. 542–544) induced me to make some numerical estimates, based upon the data furnished by him, which may be of some interest to readers of *Science*. He shows that "the area, which, lying below the Mediterranean, can possibly be flooded by it" (the united areas of the depressed portions), is, by M. Roudaire's measurements, about 3,100 square miles; and the average depth, if flooded, would be 78 feet. Now, assuming the area of the cross-section of the water of the Inlet Canal to be 2,000 square feet, and the average velocity of the inflowing water during the whole time of flooding to be 2 feet per second (not a low estimate), it follows that the average inflow would be 4,000 cubic feet per second $=3{,}456\times10^5$ cubic feet per day $= 1{,}262{,}277\times10^5$ cubic feet per year.

Again: 3,100 square miles $= 864{,}230\times10^5$ square feet; and, the average depth being 78 feet, the amount of water required to flood it to this depth $= 67{,}409{,}971\times10^5$ cubic feet. Consequently such a canal would require 53.4 years to flood the comparatively small and shallow Saharian lake, under the assumption that during the inflow no water was lost by evaporation or by absorption into the porous bed.

In such an arid and hot climate, evaporation alone would probably prolong the time of flooding for hundreds of years : indeed, the time might be prolonged indefinitely, for the loss by evaporation might ultimately be equal to the supply by inflow. We have a case in point in Pyramid Lake, in Nevada, into which the bold and rapid outlet of Lake Tahoe (Truckee River) perpetually flows without flooding it. Of course, by increasing the dimensions of the Inlet Canal, or augmenting the velocity of the inflowing water, the computed time of flooding might be proportionately shortened ; but, after all, the feeble efforts of man are insignificant in relation to the great hydraulic systems of nature.

JOHN LECONTE.

Berkeley, Cal., June 29.

A dissolving smoke-ring.

The remarkable breaking-up of a smoke-ring from a locomotive in Chicago was observed by me, a few days since, in company with a mechanical engineer of New York, whose estimate of size and height I adopt. The ring rose to an elevation of about one hundred and fifty feet, and attained a diameter of twenty or twenty-five feet, as nearly as could be estimated. It broke up suddenly with a rush of the smoke *along the line of the ring* toward two centres ; namely, the smoke of the south half coming together in the centre of that half of the line, and the smoke of the north half correspondingly to a centre in the north. After these momentary and confused aggregations, all semblance of form disappeared. A vortex ring is different from the theoretic planetary ring breaking up into satellites, but aggregation of the dissolving smoke-ring is suggestive.

H. W. PARKER.

Grinnell, Io.

Surface tension and muscular contraction.

I would offer as an attempt to explain the nature of muscular contraction the hypothesis that the contraction is due to the phenomena of surface tension.

By surface tension of a liquid is meant a peculiarity presented by its surface, due to a difference in state between the molecules in the surface and those in the interior of the liquid. That there must be an essential difference between the surface of a mass and its interior follows from the fact that the molecular forces acting on any particle within the mass are equal in every direction, and so must balance one another ; while the particles in the surface film, having no particles above them, are acted on only from below and at the sides, and so are constantly drawn down against the mass : so that the liquid must be under a definite surface tension.

This surface film behaves as a perfectly elastic membrane stretched in every direction by equal tensions, and takes the form of smallest area consistent with the conditions. This tendency of the film to become as small as possible is well illustrated by the soap-bubble, which may be considered as a layer of water with two surface films. So, when left to its own molecular forces, a drop of liquid assumes that form having the smallest superficies, with a given content, which is the sphere.

When a drop of liquid rests upon a surface which it does not wet, it assumes the form of a sphere more or less flattened out ; and the greater the surface tension of the liquid forming the drop is, the more nearly does it approach the spherical form, and whatever alters its surface tension causes a corresponding alteration in the form of the drop.

Many substances, even in small quantity, exert a considerable influence on the surface tension of liquids.

If a drop of water resting upon a greasy surface, which it does not wet, be touched with a little alcohol, its surface tension is diminished, and it immediately spreads out over a larger area ; but, when the alcohol evaporates, the surface tension of the water is increased, and it again contracts into a more globular form.

Remarkable changes in form are caused when a globule of mercury is electrically polarized. In organic substances the surface tension increases with the increase of certain elements entering into their composition, and diminishes with the increase or diminution of others ; e.g., in butyric acid and acetic anhydride the increase of oxygen and diminution of hydrogen increase the surface tension.

Now, to see the bearing of this upon the contraction of a muscular fibre, it is necessary to remember that the surface tension of a liquid may be changed by a change in its composition, that the contracting elements of a muscular fibre are the cells, and that the composition of the cells is changed at the time of a contraction.

The cells are of an oblong shape extended in the axis of contraction ; and when contraction occurs the cells grow shorter and thicker, just as an oblong drop of water grows shorter and thicker when its surface tension is increased.

Now, a tendency to contraction must follow an increase in the surface tension of the cell ; and that there probably are changes in the surface tension of the cell during contraction, follows from the fact that there are chemical changes in the cell, more rapid during contraction than rest. The changes occurring in acting muscle may be identical with those in resting muscle ; but in resting muscle, restoration keeps pace with destruction, while in contraction, destruction largely exceeds restoration : so any thing hastening the decompositions within the cell may cause contraction.

Exhaustion is explained by the accumulation of products of decomposition, since fatigue in muscles in which circulation has ceased may be readily removed by renewing the current of blood.

This hypothesis may be thus summed up : the active shortening of the fibre is due to an increase in the surface tension of the substance of the cell, caused by an increase in the proportional amount of the products of decomposition. Equilibrium is restored — after the stimulus which hastened the chemical changes has ceased — by a part of the products of decomposition finding their way into the blood-current, and possibly by the remaining products helping to build up the original compound.

ELMER STARR, M.D.

Buffalo, N.Y., June 25.

Trenton natural history society.

So far as my own communications to the Trenton natural history society are concerned, the report thereof in *Science* (viii. No. 178) is a wilful misstatement. As what I did state will soon be published, it is unnecessary to enter into explanations.

CHAS. C. ABBOTT, M.D.

Trenton, N.J., July 2.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 9, 1886.

THOUGHTS ON UNIVERSITIES.[1]

No one can visit Cambridge this summer without remembering that two hundred and fifty years ago an acorn was here planted from which an oak has grown. No scholar can come from a distant state without wishing to offer his tribute, however inadequate it may be, to the wisdom which has governed the counsels of Harvard through eight generations. A graduate of Yale will, I trust, be pardoned for associating the name of his own *alma mater* with that of her elder sister. Their united influence has not only been strong in New England, but strong in other portions of the land. It is difficult to surmise what would have been the condition of American society if these foundations had never existed. Their graduates have promoted the literature, the science, the statesmanship, and the religion of the land; but more than this is true. Their methods of instruction, their unwritten laws, their high endeavors, and their academic spirit have re-appeared in each new state of the west, as each new state has initiated its social order. To be governed by the experience of Harvard and Yale is in many an educational court an appeal to common law. To establish another Harvard or another Yale, to nurture the germ from which a great university might grow, has been the aspiration of many a patriot, of many a Christian. It was a laureate of both Harvard and Yale, the sagacious Manasseh Cutler, who initiated the policy of securing in the states beyond the Alleghanies a certain portion of the public lands for the foundation of universities. Among the pioneers of California was one who went from New England 'with college on the brain;' and now every ship which enters the Golden Gate faces the buildings of a university which Henry Durant did much to establish.

The history of higher education as guided by the two oldest foundations in this country may be considered in four periods: in the first, extending from the earliest settlement until the revolution, the English college idea was dominant in its simplest form; the second, following the severance of allegiance to the crown, was the time when professional schools in medicine, law, and theology were begun; the third, beginning about the middle of this century, was marked by the formation of scientific schools; and in the present period we are looking for the fulfilment of the university ideal, brought hither by the earliest immigrants from England.

The colonial vocabulary was modest. Whatever else it might be, 'university' seemed a very great noun, to be used as guardedly as 'episcopacy' or 'sovereignty.' In the earliest mention I remember of the cradle of Harvard, the alternative is found, 'a school or colledge;' and in Connecticut, 'collegiate school' was in vogue for seventeen years. "We on purpose gave your academy as low a name as we could that it might the better stand in wind and weather," said the well-known civilians who were consulted in 1701 by Pierpont and his colleagues at the mouth of the Quinnipiac. Elsewhere, under other influences, there was not the same caution, nor the same success. Several years before the settlement of Massachusetts Bay, the Virginia company determined to set apart, at Henrico, ten thousand acres of land for 'a university,' including one thousand for a college 'for the children of the infidels.' There was another project for a university as early as 1624, which has lately been brought to light. Dr. E. D. Neill, in 'Virginia Vetusta,' calls attention to the fact that an island in the Susquehanna, which the traveller may see to the north as he crosses the railroad-bridge at Havre de Grace, was conditionally given for "the foundinge and maintenance of a universitie and such schools in Virginia as shall there be erected and shall be called *Academia Virginiensis et Oxoniensis.*" The death of the projector, Edward Palmer, interrupted his plans.

Mr. Dexter has established the fact, that, before 1647, nearly a hundred graduates of English universities had migrated to New England, three-fourths of whom were from Cambridge; and the elaborate volumes of Mullinger exhibit in great fulness the conditions of collegiate and university life as they were known to these Cambridge wanderers in the earliest half of the seventeenth century. It is evident that the university idea was then subordinate to the collegiate; logic was riding a high horse; science and literature, as then represented by mathematics and Greek, were alike undervalued. An anecdote recorded by Mullinger reveals at a glance the situation. "Seth Ward,

[1] An address before the Phi Beta Kappa society of Harvard college, July 1, 1886, by Daniel C. Gilman, president of the Johns Hopkins university.

having lighted on some mathematical works in the library of Sidney, could find no one to interpret them. The books, says his biographer, were Greek, — I mean unintelligible to all the fellows." The spirit of observation, experiment, and research, was rarely apparent; discipline by masters and tutors took precedence of the inspiration of professors. When we consider this origin, still more when we recall the poverty of the colonists, and still more when we think of the comprehensiveness of the university ideal, even in the seventeenth century, it is not strange, that, before the revolution, American colleges were colleges, and nothing more. Even degrees were only conferred in the faculty of arts. In 1774, when Governor Hutchison was discussing colonial affairs in Lord Dartmouth's office, Mr. Pownall asked if Harvard was a university, and, if not, on what pretence it conferred degrees. Hutchison replied "that they had given Masters' and Bachelors' degrees from the beginning; and that two or three years ago, out of respect to a venerable old gentleman they gave him a doctor's degree, and that the next year, or next but one, two or three more were made Doctors. . . . After so long usage he thought it would be hard to disturb the college."

It is a significant fact that at the beginning of the revolution, in 1776, George Washington was made a doctor of laws at Harvard, and, at its close in 1783, John Warren, a doctor of medicine. From that time on, there was no hesitation in the bestowal of degrees in other faculties than that of arts.

I need not rehearse the steps by which the schools of medicine, law, and theology were added to the college; cautiously, indeed (as outside departments, which must not be allowed to draw their support from the parent trunk), and yet permanently. It is a noteworthy fact that the example of Harvard and Yale in establishing theological schools has rarely been followed in other places, even where schools of law, medicine, and science have been established. It is enough to add that professional education was organized during the first thirty or forty years of this century, in a much less orderly way than that in which the colleges were instituted.

The third period in the development of higher education was the recognition of the fact, that, besides the three traditional professions, a multitude of modern vocations required a liberal training. In consequence of this, came scientific schools, often, at first, adjacent to the classical colleges, and sometimes on independent foundations, many of these schools being aided by the national provision for technical instruction and by other noteworthy gifts.

We are now fairly entered upon the fourth period, when more attention than ever before will certainly be given to the idea of the university, — an idea long dormant but never dead. The second decennium of this century was but just begun, when a university was chartered in Maryland; and before it closed, the first of the western universities, endowed by a gift of the public lands, was organized in the county and town of Athens, O., precursor of the prosperous foundation in Michigan, and of like institutions in other parts of the old north-western territory. Early in this century, Americans had frequently gone abroad for medical and scientific training, but between 1820 and 1830 many turned their eyes to Germany for historical and philological study; and the line which began with Everett, Ticknor, Bancroft, and Woolsey, has been unbroken to this day. Through these returning wanderers, and through the importation from Germany, England, and Switzerland, of foreigners distinguished as professors, — Lieber and Beck, Sylvester and Long, Agassiz and Guyot, and their compeers, — the notion of a philosophical department of a university, superior to a college, independent of and to some extent introductory to professional schools, has become familiar. But the boldest innovation, and the most influential, was the work of one whose name is perpetually associated with the Declaration of Independence and the University of Virginia. It was in 1826 that his plans assumed form, and introduced to the people of this country — not without some opposition — the free methods of continental universities, and especially of the University of France.

Thus, as years have rolled on, the word 'university,' at first employed with caution, has been reiterated in so many connections, that it has lost its distinctive significance, and a special plea must be made for the restoration to its true sovereignty, of the noblest term in the vocabulary of education. Notions injurious and erroneous are already abroad. Poor and feeble schools, sometimes intended for the destitute, beg support on the ground that they are universities. The name has been given to a school of arts and trades, to a school of modern languages, and to a school in which only primary studies are taught. Not only so, but many graduates of old and conservative institutions, if we may judge from recent writings, are at sea. There are those who think that a university can be made by so christening it; others who suppose that the gift of a million is the only requisite; it is often said that the establishment of four faculties constitutes a university; there is a current notion that a college without a religion is a university, and another that a college without a

curriculum is a university. I have even read in the newspapers the description of a building which "will be, when finished, the finest university in the country;" and I know of a school for girls, the trustees of which not only have the power to confer all degrees, but may designate a board of lady managers possessing the same powers.

Surely it is time for the scholars of the country to take their bearings. In Cambridge the anniversary so soon to be celebrated will not be allowed to pass without munificent contributions for most noble ends; the president of Yale college, who this day assumes his high office with the unanimous plaudits of Yalensians, is the representative of the university idea based upon academic traditions; the voice of Princeton, like a herald, has proclaimed its purposes; Cornell has succeeded in a litigation which establishes its right to a large endowment; the secretary of the interior has commended to congress the importance of a national university, and a bill has been introduced looking towards such an establishment; the Roman Catholic Church, at its recent council in Baltimore, initiated measures for a university in the capital of the nation; while on the remotest borders of the land the gift of many millions is assured for promoting a new foundation. Already, in the Mississippi valley, men are laboriously unfolding their lofty ideals. It is therefore a critical time. Wise plans will be like good seed: they will spring up, and bear fruit a hundred-fold. Bad plans will be like tares growing up with the wheat, impossible to eradicate.

It is obvious that the modes of organization will vary, so that we shall have many different types of universities. Four types have already appeared,—those which proceed from the original historic colleges, those established in the name of the state, those avowedly ecclesiastical, and those which are founded by private benefactions. Each mode of organization has advantages which may be defended, each its limitations. If the older colleges suffer from traditions, the younger lack experience and historic growth. The state universities are liable to political mismanagement: ecclesiastical foundations are in danger of being narrow.

Under these circumstances, I ask you to consider the characteristics of a university, the marks by which it should be distinguished.

It is needless before this audience to repeat the numerous definitions which have been framed, or to rehearse the brilliant projects which have been formed by learned, gifted men; but I hope it will not be amiss to recall some of the noble aims which have always inspired endeavors to establish the highest institutions of learning.

Among the brightest signs of a vigorous university, is zeal for the advancement of learning. Another phrase has been lately used, the 'endowment of research.' I prefer the other term; for it takes us back to the dawn of modern science, and connects our efforts with those of three hundred years ago, when Francis Bacon gave an impulse to all subsequent thought, and published what his recent biographer has called the first great book in English prose of secular interest, — "the first of a long line of books which have attempted to teach English readers how to think of knowledge, to make it really and intelligently the interest, not of the school or the study or the laboratory only, but of society at large. It was a book with a purpose, new then, but of which we have seen the fulfilment."

The processes by which we gain acquaintance with the world are very slow. The detection of another asteroid, the calculation of a new orbit, the measurement of a lofty peak, the discovery of a bird, a fish, an insect, a flower, hitherto 'unknown to science,' would be but trifles if each new fact remained apart from other facts; but, when among learned men discoveries are brought into relations with familiar truths, the group suggests a law, the law an inference, the inference an experiment, the experiment a conclusion; and so from fact to law, and from law to fact, with rhythmic movement, knowledge marches on, while eager hosts of practical men stand ready to apply to human life each fresh discovery. Investigation, co-ordination, and promulgation are not performed exclusively by universities; but these processes, so fruitful in good, are most efficient where large numbers of the erudite and the acute, of strong reasoners and faithful critics, are associated for mutual assistance, correction, and encouragement. It is an impressive passage with which the lamented Jevons closed his 'Principles of science.' After reminding the reader of the infinite domain of mathematical inquiry, compared with which the whole accomplishments of a Laplace or a Lagrange are as the little corner of the multiplication table, which has really an indefinite extent, he goes on to say that inconceivable advances will be made by the human intellect unless there is an unforeseen catastrophe to the species or the globe. "Since the time of Newton and Leibnitz, whole worlds of problems have been solved, which before were hardly conceived as matters of inquiry. In our own day, extended methods of mathematical reasoning, such as the system of quaternions, have been brought into existence. What intelligent man will doubt that the recondite speculations of a Cayley or a Sylvester may possibly lead to some new methods, at

the simplicity and power of which a future age will wonder, and yet wonder more that to us they were so dark and difficult?"

Let me draw an illustration from another science which will be acknowledged as of transcendent importance even by those, if such sceptics there be, who have no confidence in transcendental mathematics. Cohnheim, the great pathologist of Germany, whose death occurred in 1884, declares, in the introduction to his 'General pathology,' that the study of the causes of disease is absolutely without limits, for it touches upon the most heterogeneous branches of science. Cosmical physics, meteorology and geology, not less than the social sciences, chemistry, as well as botany and zoölogy, all bring their contributions to that branch of pathology. So, with all his knowledge and ability, this leader in pathology restricted his own work to the study of disordered physiological functions. But what prevention of suffering, what sanitary alleviations, what prolongation of life, may we not anticipate in future generations, when man thoroughly understands his complex environment, and adapts himself to it?

In the accumulation of knowledge, as of other forms of wealth, saving must follow earning. So among the offices of a university we find the conservation of experience. Ignorant as the nineteenth century appears when we survey the long category of inquiries now held in abeyance by mathematicians, astronomers, physicists, chemists, and biologists, by ethnologists, philologers, historians, and publicists, let us ask how much man has advanced since the ages of stone, of iron, and of brass. Such books as Tylor's and Morgan's, such observations as those of Livingstone and Stanley, show us what man is without a history; what society is where no storage is provided for the lessons learned by successive generations, and where the wisest and best are content to pass away, leaving no sign. It is the business of universities, not only to perpetuate the records of culture, but to bring them out in modern, timely, and intelligible interpretations, so that all may know the laws of human progress, the dangers which imperil society, the conditions of advancing civilization. Experiments upon fundamental laws — such as the establishment of home rule, and the adjustment of the discord between industry and capital — may destroy or may promote the happiness of many generations. That mistakes may not be made, historical politics must be studied, and what is this but the study of the experience of mankind in endeavors to promote the social welfare? As there have been great lawgivers in the past, whose codes have been put to secular tests, so momentous experiments have run through centuries, and involved the welfare of nations, — experiments which have been recorded and interpreted, but which call for still closer study, by the wisest intellects, before their lessons are exhausted. Can such researches be made in a moment? Can they be undertaken by a knight of labor? Are the facts to be gathered in a circulating library? Or must we depend upon scholars trained to handle the apparatus of learning? Gladstone and Bryce and Morley may or may not be right in all the subordinate features of the measures which they are advocating; but their influence at this very moment is resting on the fulcrum of historic knowledge, the value of local self-government. Hamilton, Jefferson, Madison, and Marshall were far from being 'inspired' when they initiated the constitutional measures by which the United States are governed; and there is abundant evidence to show that they were students of the past experience of mankind in confederated politics. The compact of the Mayflower was reduced to writing within the sheltering arm of Cape Cod; but its ideas are those of men who knew the laws of Moses and Solomon, and who had seen in Holland, as well as in England, what favors and what hinders the development of civil and religious liberty. Within the shadow of the University of Leyden, a stone marks the spot where John Robinson lived, taught, and died; and the name of Elder Brewster of the Mayflower has been recently discovered among the matriculates of Peterhouse, Cambridge. In our day the pioneers of 1849 carried with them to the remotest shores of the continent ideas which soon took the form of laws, customs, colleges, schools, churches, hospitals, unknown under the Mexican sway; but they had learned these ideas in the historic schools of the Atlantic seaboard.

The universities are the natural conservators of educational experience, and should be recognized as the guides of public education. In a better state of society, means will be found to make the men of learning in a given generation responsible for the systems of primary teaching; giving potency to their counsel not only at the end but in every stage of scholastic life. Upon text-books, courses of study, methods of discipline, the qualifications of teachers, the value of rewards, honors, and examinations, the voice of the universities should be heard. The confusion and uncertainty which now prevail are indications that in schools of the lowest as of the highest grades, re-adjustments are needed which can only be wisely directed by those whose learning embraces the experience of many generations. The wisest are none too wise in pedagogics, but they are better counsellors than the ignorant.

Dr. Lieber, in a letter to Secretary Seward, at the close of the civil war, presented a strong plea for the reference of international disputes to universities. Reminding the secretary that their authority had been invoked upon internal controversies in France and Germany, he asked, Why not refer to them in international affairs? The law faculty of a renowned university in a minor state would seem, he says, "almost made for this high function, and its selection as a court of international arbitration would be a measure worthy of England and the United States;" and he risks the prophecy that "the cis-Caucasian race will rise at no very distant day to the selection of such umpires, far more dignified than a crowned arbitrator can be."

Among the offices of a university, there is one too often undervalued, or perhaps forgotten, — the discovery and development of unusual talent. I do not speak of genius, which takes care of itself. Nobody can tell how it comes to pass that men of extraordinary minds are born of commonplace parentage, and bred in schools of adversity, away from books and masters. Institutions are not essential to their education. But every one who observes in a series of years the advancement of men of talents, as distinguished from men of genius, must believe that the fostering diet of a university — 'its plain living and high thinking' — favors the growth of scholars, investigators, reasoners, orators, statesmen of enduring reputation, poets, and discoverers. Such men are rarely produced in the freedom of the wilderness, in the publicity of travel and of trade, or in the seclusion of private life; they are not the natural product of libraries and museums, when these stand apart from universities; they are rarely produced by schools of a lower grade. Exceptions are familiar; but the history of civilization declares that promising youth should have the most favorable opportunities for intercourse with other minds, living as well as dead, comrades as well as teachers, governors as well as friends. It declares that in most cases talents will seize opportunity, and opportunity will help talents. Just now, in our own country, there is special reason for affirming that talents should be encouraged without respect to property. Indeed, it is quite probable that the rich need the stimulus of academic honors more than the poor: certainly the good of society requires that intellectual power, wherever detected, should be encouraged to exercise its highest functions.

Cardinal Newman (in a page which refers to Sir Isaac Newton's perception of truths, mathematical and physical, though proof was absent; and to Professor Sylvester's discovery, a century and a half later, of the proof of Newton's rule for ascertaining the imaginary roots of equations) says that a parallel gift is the intuitive perception of character possessed by certain men; as there are physicians who excel in diagnosis, and lawyers in the detection of crime.

Maurice, the greatest theologian of our day, was so strong an advocate of university education, that he suggests a sort of *quo warranto* forcing "those who are destined by their birth or property to any thing above the middle station in society, and intended to live in England, . . . to show cause why they do not put themselves in the best position for becoming what Coleridge calls the 'clerisy' of the land."

Devotion to literature will always distinguish a complete university. Within the academic walls you may always find the lover of humanities; here in perpetual residence, those who know the Athenian dramatists, the Augustan poets, the mediaeval epic writers, Chaucer and Shakspeare, and the leaders in literature of every name and tongue. In the class-rooms of the university, successive generations of youth should be presented to these illustrious men. The secrets of their excellence should be pointed out; the delights of literary enjoyment should be set forth; the possibilities of production in our day should be indicated; and, withal, the principles of criticism should be inculcated, as remote from sarcasm and fault-finding on the one hand, as from prostrate adoration and overwrought sympathy on the other.

It is common in these days to lament that the taste of the public, as indicated by the remorseless self-recording apparatus of the public libraries and the glaring indications of the book-stalls, is depraved; but it is well to remember that many counteracting influences are vigorous. Never was Shakspeare read and studied as he is to-day; never was Chaucer so familiar to the youth at school; never was the Bible so widely read; never were such translations accessible as are now within reach of all. In all this, the power of the universities is felt: give them the credit. But let us hope that in the future more attention than ever before will be given to the study of literature and art. Fortunate would it be if in every seat of learning such a living teacher could be found as a Wordsworth, a Tennyson, a Browning, or a Lowell.

Among the characteristics of a university, I name the defence of ideality, the maintenance of spiritualism. There are those in every generation who fear that inquiry is hostile to religion. Although universities are the children of the Christian church, although for a long period the papal

sanction was desirable if not essential to their establishment, although the earliest colleges in this country were strictly religious, and although almost every denomination in the land desires its own university, there is an undercurrent of talk which shows that the influence of the higher education is often regarded in certain circles as adverse to spiritual and religious life. If this were so, many would prefer to see the academic walls fall down in a night, and the treasures of the ages reduced to smoke and ashes. But fortunately, indeed, there is no such danger. Alarmists are cowards. That piety is infantile which apprehends that knowledge is fatal to reverence, devotion, righteousness, and faith. As the most recent utterances of science point more and more steadily to the plan of a great designer, as the studies of psychology and of history confirm the doctrine, at least as old as Solomon, that righteousness exalteth a nation, so we may affirm that the two essentials of Christianity, on which hang all the law and the prophets, — the love of God and the love of our neighbor,— are enforced and not weakened by the influence of universities. We may also rest assured that institutions devoted to the ascertainment of truth as the ultimate object of intellectual exertion, and to the promulgation of truth as an imperative moral obligation, are not the harbingers of harm. Individuals will err; generations will labor under false ideas; domineering intellects will dazzle for a time the ordinary mind; error, like disease, must be clearly understood before the mode of correction can be formulated; but there is no better way known to man for securing intellectual and moral integrity than to encourage those habits, those methods, and those pursuits which tend to establish truth.

Near the close of his address before the University of Munich, at the celebration of its jubilee in 1872, a great theologian, Dr. Döllinger, referred to the perils of the times in words which were received with prolonged applause. "Who knows," said he, "but that for a time Germany may remain confined in that strait prison, without air and light, which we call materialism? This would be a forerunner of approaching national ruin. But this can only happen in case the universities of Germany, forgetting their traditions and yielding to a shameful lethargy, should waste their best treasures. But no, our universities will form the impregnable wall ready to stop the devastating flood."

The maintenance of a high standard of professional learning may also be named among the requisites of a university. So it is on the continent of Europe, so partially in Great Britain, so it should be everywhere. The slender means of our fathers compelled them to restrict their outlays to that which was regarded as fundamental or general education; and so it came to pass (as we have already been reminded) that professional schools were established in this country as independent foundations. Even where they are placed under the university *aegis*, they have been regarded as only children by adoption, ready enough for the funds which have been provided for academic training, but without any claims to inherit the birthright. The injury to the country from this state of things is obvious. The professional schools are everywhere in danger of being, nay, in many places they actually are, places of technical instead of liberal education. Their scholars are not encouraged to show a proficiency in those fundamental studies which the experience of the world has demanded for the first degree in arts. It is well known that many a medical school graduates young men who could not get admission to a college of repute. Ought we, then, to wonder that quackery is popular, and that it is better to own a patent medicine than a gold-mine? It was a wise and good man who said that there is no greater curse to a country than an uneducated ministry, and yet how common it is for the schools of theology in this country to be isolated from the best affiliations! Lawyers are too often trained with reference to getting on at the bar, and find themselves unprepared for the higher walks of jurisprudence and statesmanship. The members of congress and of the state legislatures annually exhibit to the world poverty of preparation for the critical duties which devolve upon them. I am far from believing that university schools of law, medicine, and theology, will settle the perplexing questions of the day, either in science, religion, or politics; but, if the experience of the world is worth any thing, it can nowhere be so effectively and easily acquired as in the faculties of a well-organized university, where each particular study is defined and illuminated by the steady light which comes from collateral pursuits, from the brilliant suggestions of learned and gifted teachers. Moreover, science has developed in modern society scores of professions, each of which requires preparation as liberal as law, medicine, or theology. The schools in which modern sciences are studied may indeed grow up far apart from the fostering care of universities; and there is some advantage doubtless, while they are in their early years, in being free from academic traditions: but schools of science are legitimate branches of a modern university, and are gradually assuming their proper relations. In a significant paragraph which has lately appeared in the newspapers, it is said, that, with the new arrange-

ments for instruction in the University of Cambridge, Eng., its degree of engineer will be one of the most valuable which can anywhere be attained.

Finally, among the merits of a university, is the cultivation of a spirit of repose. As the distractions of modern civilization multiply, as newspaper enterprise brings to our daily vision the conflicts and transactions of mankind, as books become superabundant, and periodicals more and more indispensable, — and more and more technical, — some corrective must exist, or there will be no more enjoyment in an intellectual life than there is in making money in the turmoil of the bourse. The whirl of the nineteenth century has already affected the colleges, with detriment to that seclusion which best promotes the acquisition of knowledge. A man of great experience in public affairs has said that a great university should be at once "the best place of education, the greatest machine for research, and the most delicious retreat for learned leisure." This is doubtless the truth, but it is only a half-truth. Universities with ample resources for the support of investigators, scholars, thinkers, and philosophers, numerous enough, learned enough, and wise enough to be felt among the powers of the age, will prove the safeguards of repose, not only for those who live within their learned cloisters, but for all who come under their influence. A society of the choicest minds produced in any country, engaged in receiving and imparting knowledge, devoted to the study of nature, the noblest monuments of literature, the marvellous abstractions of mathematical reasoning, the results of historical evidence, the progress of human civilization, and the foundations of religious faith, will be at once an example of productive quietude, and an incitement to the philosophic view of life, so important to our countrymen in this day, when the miserable cry of pessimism on the one hand, and the delightful but deceitful illusions of optimism on the other hand, are in danger of leading them from the middle path, and from that reasonableness of mind which first recognizes that which is, and then has the hope and courage to strive for the better.

In what has now been said, it has been made apparent that our fathers brought with them to the western world the idea of a university as an institution superior to, though not exclusive of, a college, and that this idea, sometimes obscured by mist, has never lost its radiance. I have also called your attention to some of the functions which are embodied in the conception of a university, — the advancement of learning, the conservation of knowledge, the development of talent, the promotion of spirituality, the cultivation of literature, the elevation of professional standards, and the maintenance of repose.

I add a few suggestions of a practical character, which I hope will be approved in this seat of learning.

We should look for the liberal endowment of universities to the generosity of wealthy individuals. It is doubtful whether the national government, or the government of any state, will ever provide funds which will be adequate for the highest education. There is a growing disposition in the eastern states to restrict all provision for public instruction to schools of primary and secondary rank. Were any legislative body to appropriate a sufficient financial support, there is nothing in the tendencies of modern politics to show that the representatives of the people, as they are in these days elected, would have the wisdom to mark out the pathway of a great university. Ecclesiastical zeal is more likely to be successfully invoked. The conception of a university pervaded by a spirit of enlightened Christianity is inspiring to the mind of every believer. It seems to associate religion and science as co-workers for the good of man. It is more than probable, under this consideration, that a Catholic university will ere long be initiated; and, if it succeeds, the example may lead to a union of Protestants for a kindred object. But it would be a misfortune and an injury, as I believe, to the religious progress of the country, if each of the denominations into which the evangelical world is divided were to aim at the maintenance of a university under its own sectarian name. The endowments which are called for are too large to be made up by petty contributions. Great gifts are essential, and consequently those who in the favorable conditions of this fruitful and prosperous land have acquired large fortunes should be urged by all the considerations of far-sighted philanthropy to make generous contributions for the development of the highest institutions of learning. There is now in the golden book of our republic a noble list of such benefactors. Experience has shown no safer investments than those which have been given to learning, — none which are more permanent, none which yield a better return.

It is a common error in this country to suppose that we need many universities. Just the reverse is true: we need but few, but we need them strong. There is great danger that funds will be scattered, teachers isolated, and scholars kept away from their proper fields, by attempts, of which we have seen too many, to establish post-graduate courses with very inadequate means.

Even professional schools have been initiated where the fees of the pupils have been the only criteria of success. We should lend our influence as scholars to enlarging the resources of the universities which are strong, and to discouraging new foundations unless there is a positive guaranty that they are also to be strong. There are half a dozen or more places which could be named where a million of dollars would be more fruitful than thrice that sum in any new establishment. No greater service could be rendered at this time than a rigid enforcement of the scriptural rule, "For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath."

There is another danger to which I must call attention, — the danger of an incorrect conception of the purposes which should influence young men in pursuing university courses beyond a college curriculum. Those who have watched the tendencies of graduated students must have observed with a good deal of alarm the disposition which they sometimes show to concentrate attention upon very special subjects. Unfortunately many of these same persons are entirely dependent for their support on the salaries which they may earn. Now, instead of bringing to the educational exchange qualities which are always in demand, and which always receive remuneration, they come forward as doctors of philosophy with special attainments in some limited field, and are saddened to find that there is no demand for the acquisitions which they offer. I do not hesitate to say that if the drift of university work in this country is toward premature and excessive specialization, many a mariner is doomed to shipwreck on that rock. Even in Germany, where specialization has been favored, the cry is heard, too many specialists, too many university candidates. It would be a misfortune to this country, if we should find in the course of a few years a superabundance of men with rare acquisitions of a kind for which there is no demand. It would then be rightly said that our universities did not produce the fruit which had been expected. On the other hand, if residence in a university, beyond the college course, is found to widen the student's capacities as it increases his knowledge; if he learns the art of imparting what he knows; if he acquires the sense of proportion, and sees the subjects which he studies with the right perspective; if he strengthens the foundations as he carries upward the obelisk,— then he will gain, and not lose, by prolonged preparation for the duties of life. For every individual who may with wisdom be encouraged to devote himself to a very limited domain, there are scores who may be bidden to widen their culture. I do not now refer to those upon whom fortune has smiled, and who have the means to do as they please in preparing for life; but I have in mind many a struggling aspirant for the scholar's fame, who would be a happier and a more useful man if he had not set his face so resolutely against those studies which adorn the intellectual character, and give grace, dignity, and acceptability to their possessor. The first business of every man is to win his bread; if he is sure of that, he may wander at his own sweet will through meadows and woods.

In all the difficulties which are encountered by those who are endeavoring to advance the institutions of this country to their highest usefulness, great encouragement may be derived from a study of the results secured in other countries and in other ages. It is only by the review of long periods of time that the most instructive lessons can be learned. The history of European universities is yet to be written by one who has the requisite vision, and who can estimate with an accurate judgment the various forces by which they have been moulded, and the various services they have rendered to humanity. But there are many histories of famous foundations, many biographies of illustrious teachers, many surveys of literature, science, and education, many elaborate schemes of organization, and many proposals of reform. The mind of a master is indeed needed to co-ordinate what is thus recorded, — to be the interpreter of the house called beautiful. But the American scholar need not wait for such a comprehensive work; the American philanthropist need not delay his benefactions until more experience is secured. The centuries speak with many voices, but they are all harmonious. From the revival of letters until now, from the days of Gerson, the great chancellor of the University of Paris, five hundred years ago, every advance in civilization has been dependent upon the influences which have proceeded from the seats of learning. Their light has illuminated the foremost nations of Christendom. In days to come, more than in days that are past, their power for good will be felt upon the interests of mankind. Let us hope and believe, let us labor and pray, that the American universities when they are fully organized may be worth allies of the strongest and best foundations, — steady promoters of knowledge, virtue, and faith.

THE sixty-ninth annual meeting of the Swiss society of natural science will be held at Geneva, Aug. 9–12.